Process Improvement and CMMI®

- Developing Complex Systems- Using CCMI® to Achieve Effective Systems and Software Engineering Integration

8th Annual CMMI Technology Conference and User Group
November 17-20, 2008
Hyatt Regency Tech Center
Denver, Colorado
Theme: Investigation, Measures, and Lessons Leaned About the Relationship Between CMMI ® Process Capability and Project or Program Performance.

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The Software Engineering Institute - Improving the Practice of Engineering: Create, Apply and Amplify

Federally Funded Research and Development Center

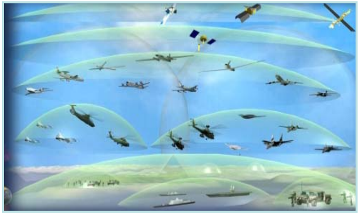
Created in 1984

Sponsored by the U.S. Department of Defense

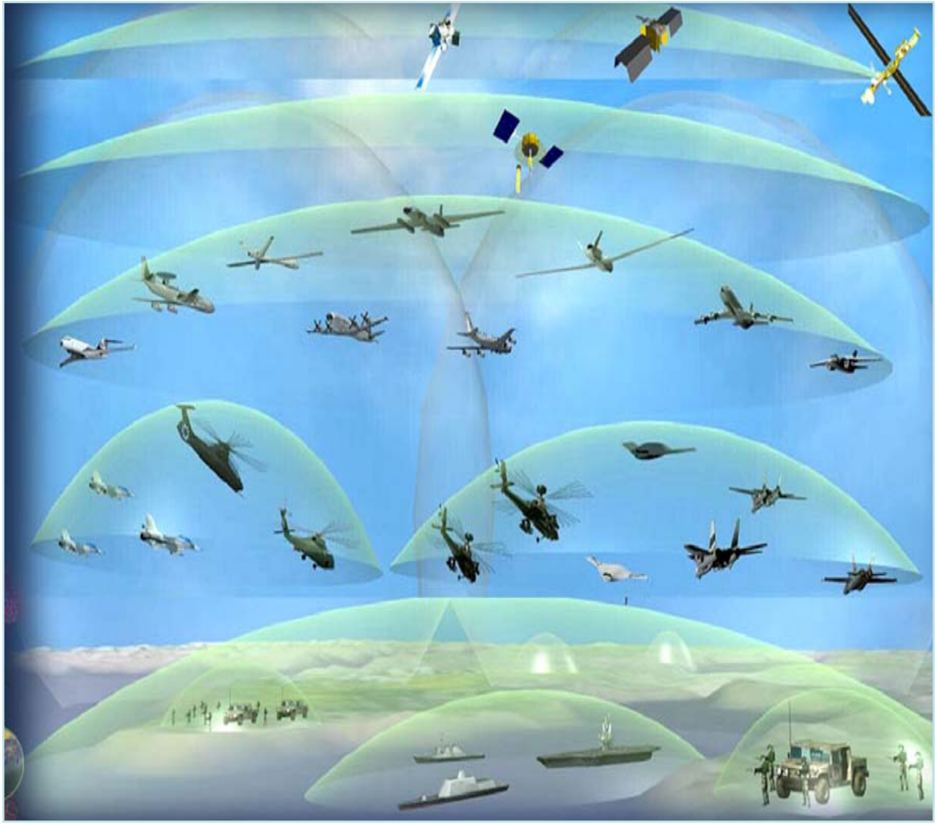
Locations in Pittsburgh, PA; Washington, DC; Frankfurt, Germany

Operated by Carnegie Mellon University

Overview

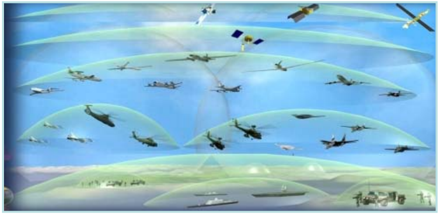


- **Integration Trends**
  - Development
  - Mission
  - Technology
  - Engineering
  - Risk
- **CMMI Benefits**
- **Ten Future Trends**
- **Wrap-up**



Development Complexity

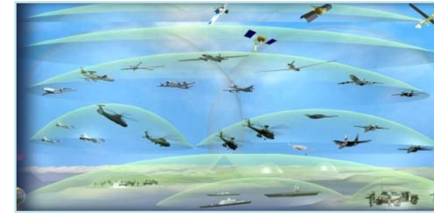
Need for Space, Air, Ground, Water, Underwater Software-Intensive Systems to be Integrated



- Several million SLOC programs; “Hybrid” systems combining legacy re-use, COTS, new development
- Multi-contractor teams using different processes; dispersed engineering, development & operational locations
- New technologies create opportunities/challenges; products change/evolve, corporations mutate
- Business/operational needs change - often faster than full system capability can be implemented
- Skillset Shortfalls; Cost and schedule constraints
- Demands for increased integration, interoperability, system of system capabilities
- Enterprise perspectives/requirements; sustainment concerns

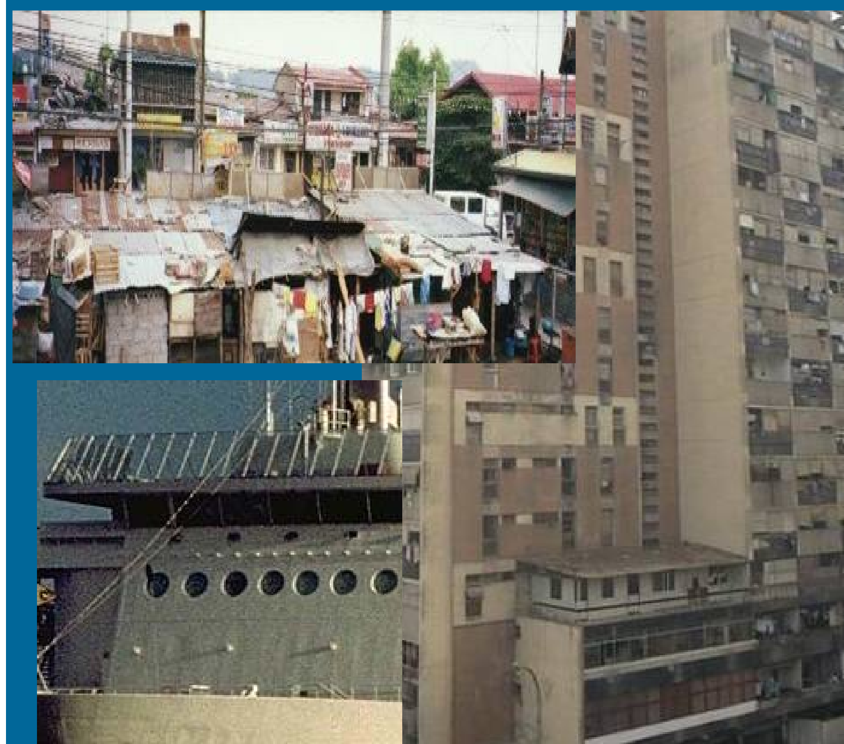
Development Complexity of Software-Intensive Systems is Increasing

Need for Mission Integration

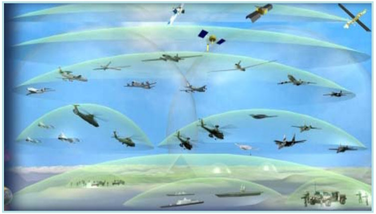


Less a Matter of Hitting a Window

And More a Matter of The Right Window - Right Now



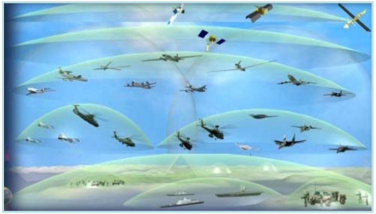
Software Engineering Trends That Impact Systems Engineering

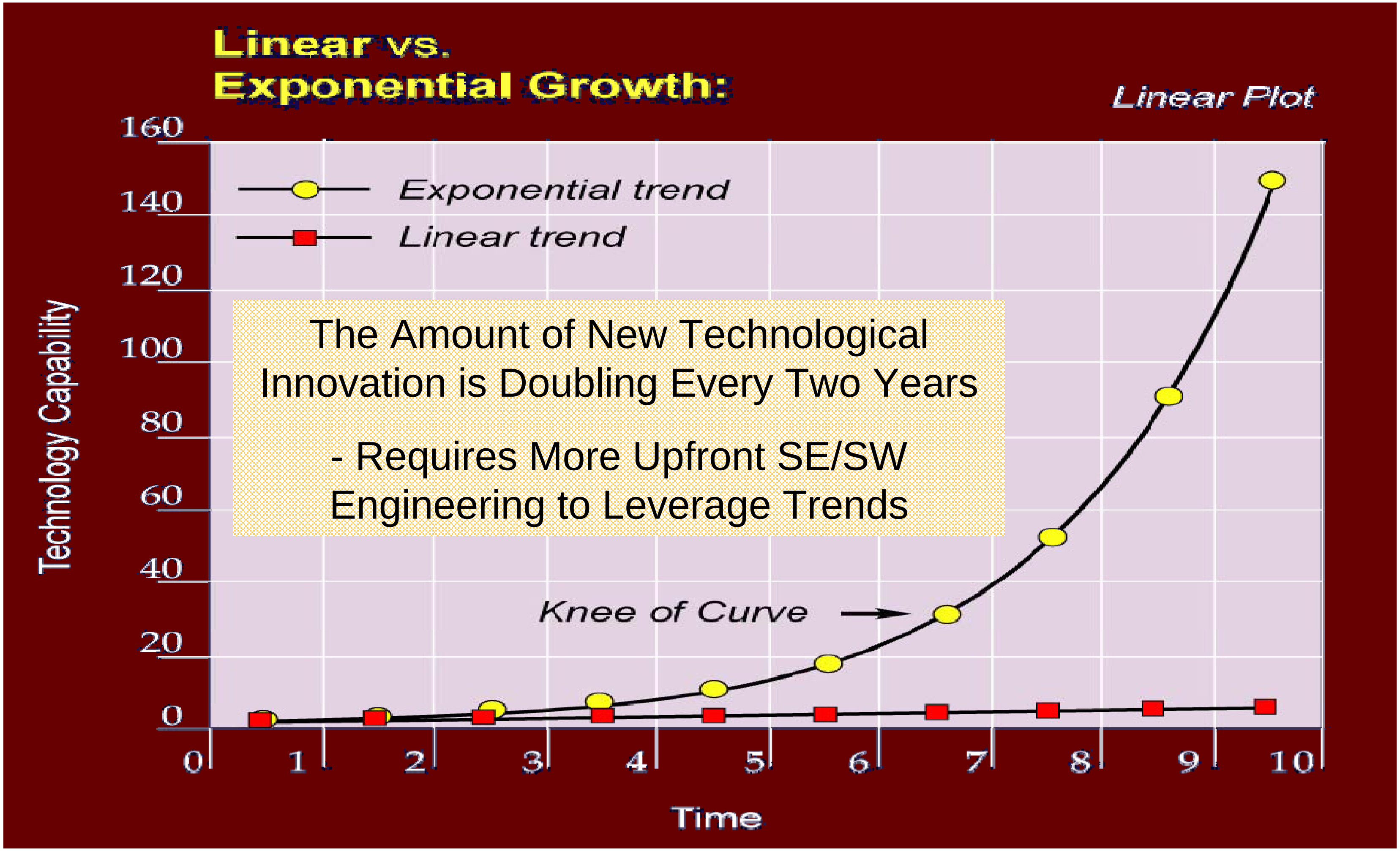


Traditional	Future
• Standalone systems	• Everything connected-maybe
• Mostly source code	• Mostly COTS components
• Requirements-driven	• Requirements are emergent
• Control over evolution	• No control over COTS evolution
• Focus on software	• Focus on systems and software
• Stable requirements	• Rapid change
• Premium on cost	• Premium on value, speed, quality
• Staffing workable	• Scarcity of critical talent

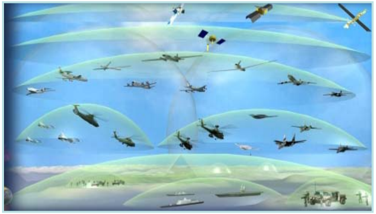
Emerging Dynamics of Bringing Systems and Software Engineering in Continued Partnership

The Acceleration of Innovation in the 21st Century:
- Facilitating Our Ability to Integrate

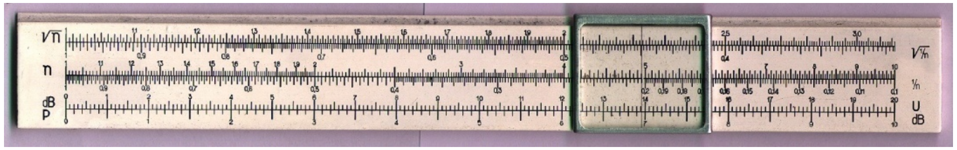


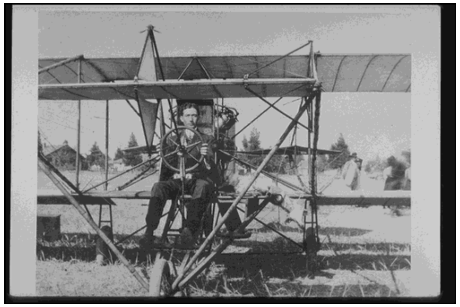


Facilitating Integration: Augustine's Law - Growth of Software is an Order of Magnitude Every 10 Years



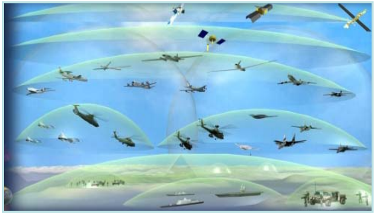
In The Beginning





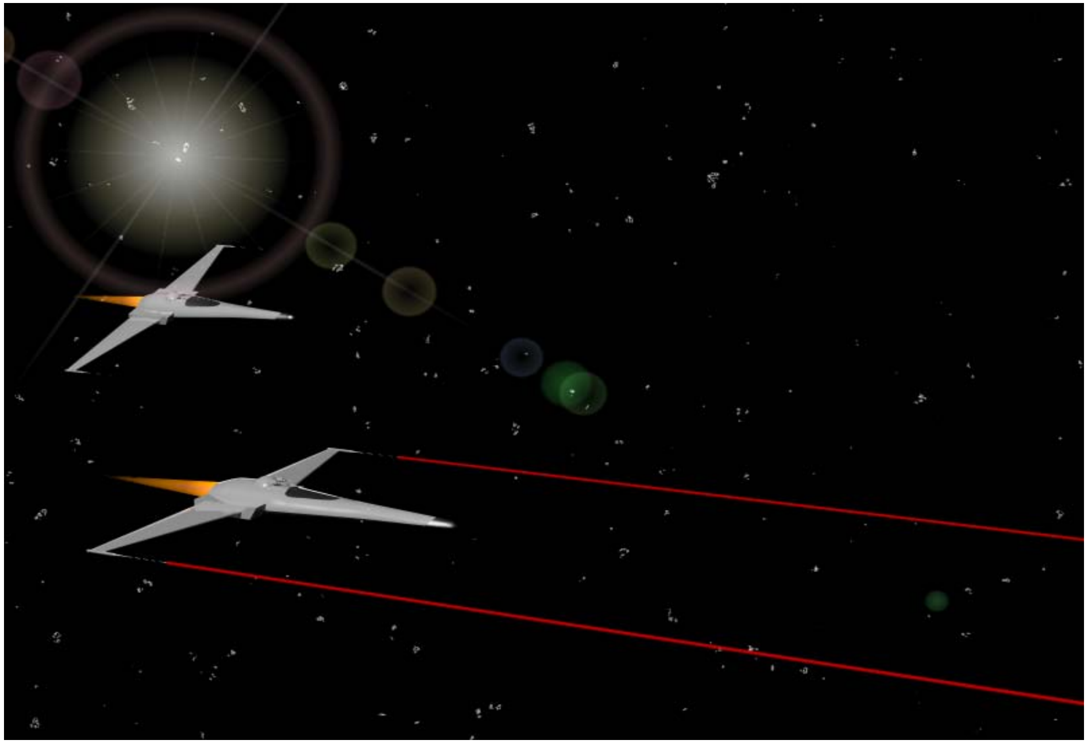
1960's	***1970's***	***1980's***	***1990's***	***2000+***
				
F-4A 1000 LOC	***F-15A 50,000 LOC***	***F-16C 300K LOC***	***F-22 1.7M LOC***	***F-35 >6M LOC***
				

Facilitating Integration: Given Augustine's Law Holds



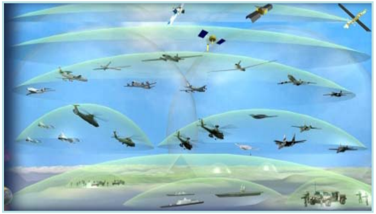
2080?

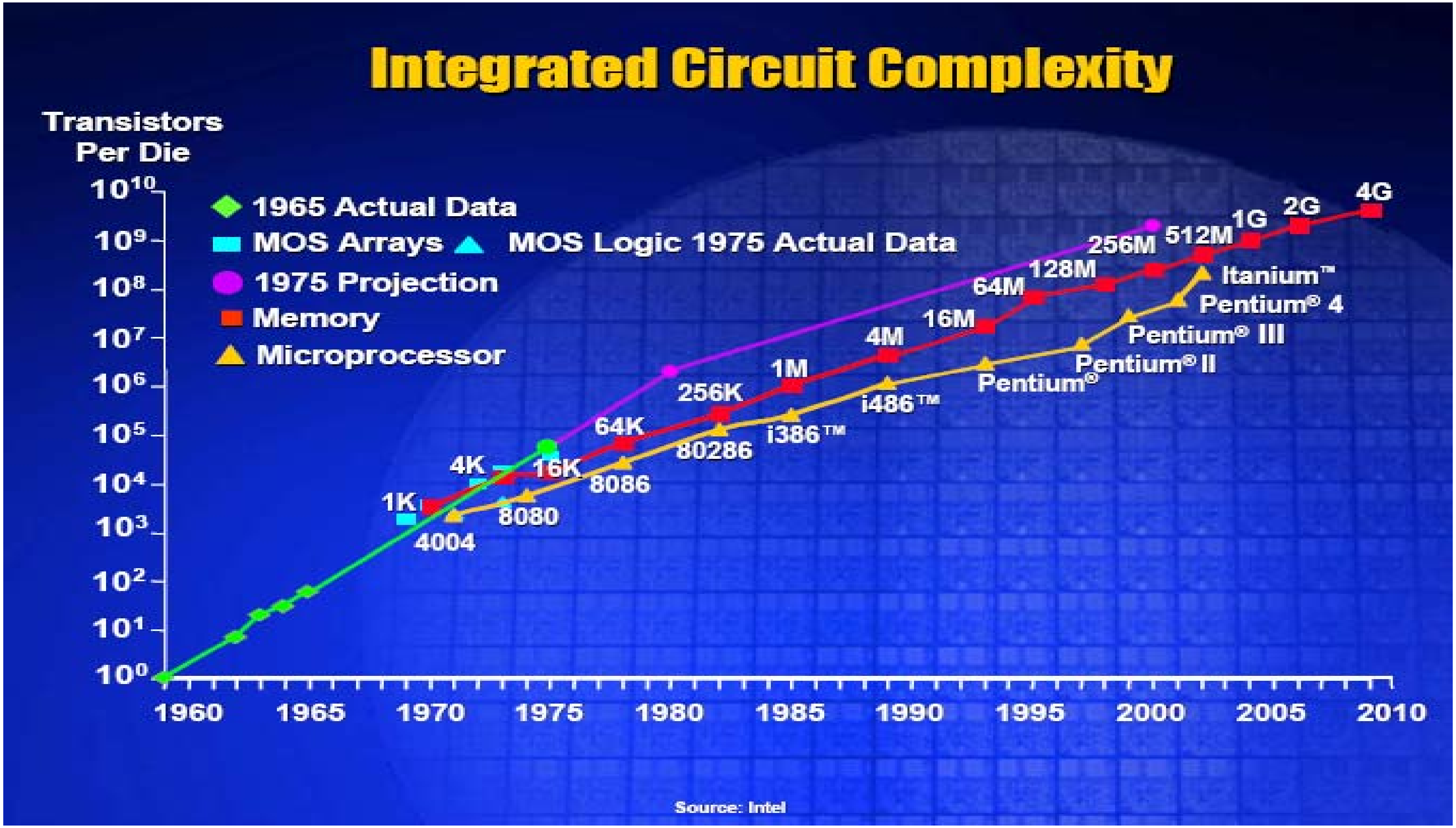
F-50 - 4.7B Lines of Code



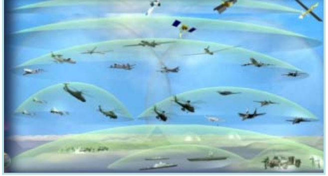
Need for increased functionality will be a forcing function to bring the fields of software and systems engineering closer together

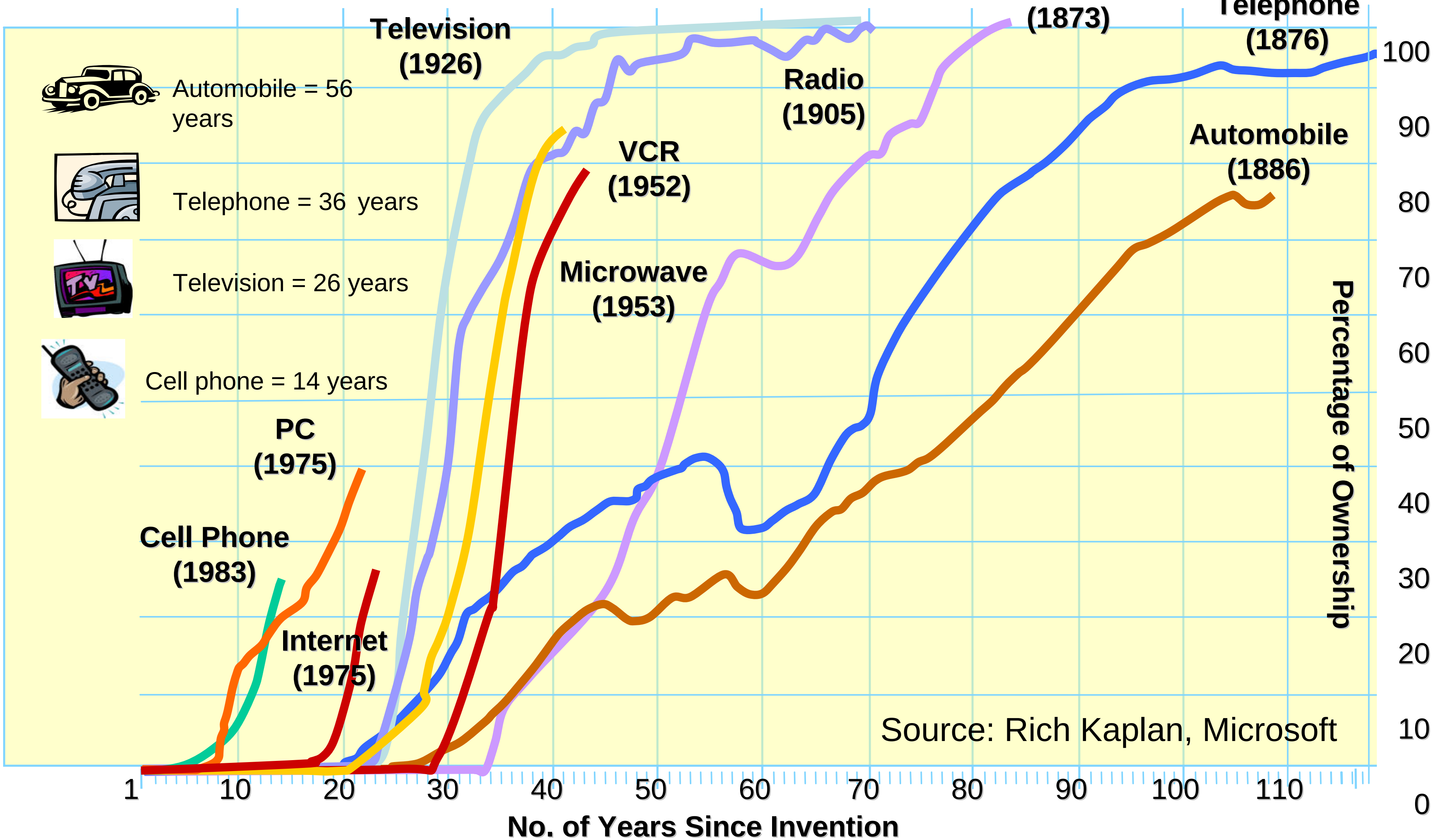
Facilitating Integration: Moore's Law - The Number of Transistors That Can be Placed on an Integrated Circuit is Doubling Approximately Every Two Years



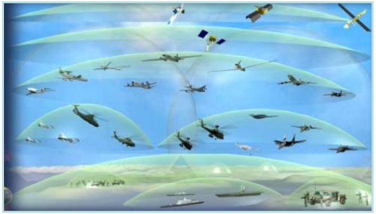


Facilitating Integration: Increased Technological Rate of Adoption

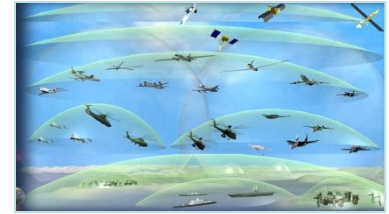




Management Integration: Life of a Program Manager in a System of Systems Operation…



Relationship Between Integration Complexity and Acquisition Success Improving and More Improvements are on the Way But …..



Software is Growing in Complexity

- 80% of some weapon system functionality is dependent upon software
- Consequences of software failure can be catastrophic

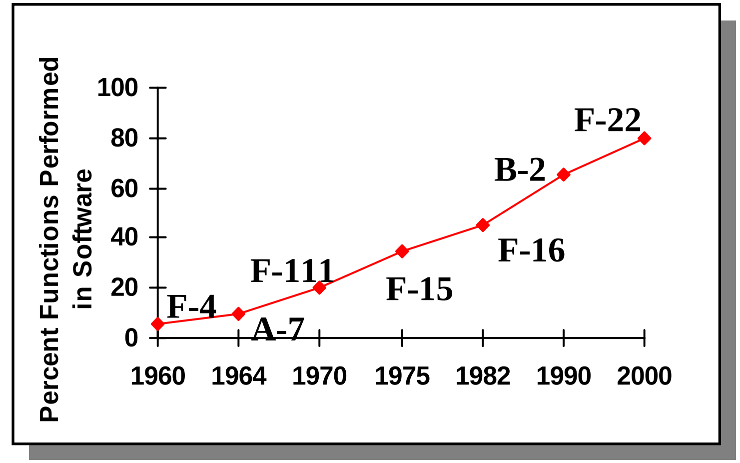
Software Acquisition is Difficult

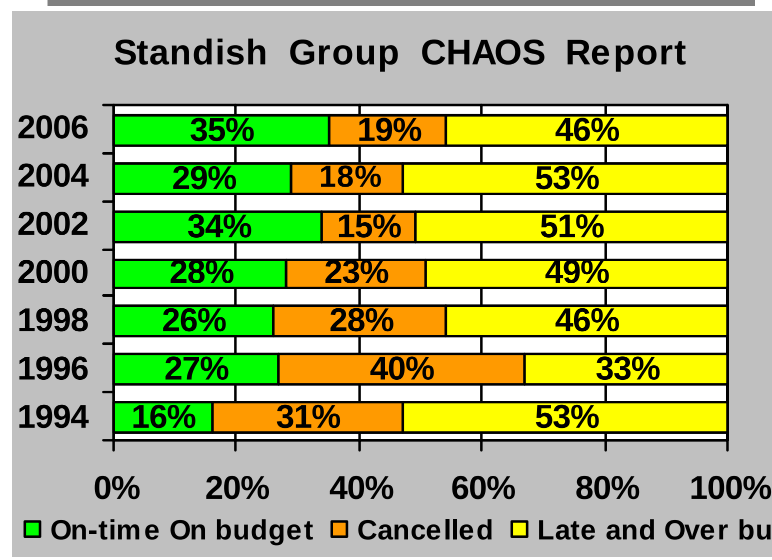
- 46% are over-budget (by an average of 47%) or late (by an average of 72%)
- “Successful projects” have 68% of specified features

Software is Pervasive

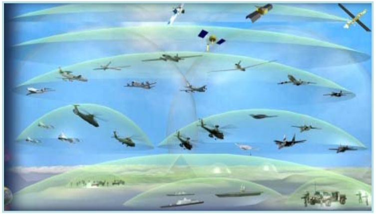
- IT Systems, C4ISR, Weapons, etc

On-going Changes to the Acquisition Process Targeted at Correcting this Issue





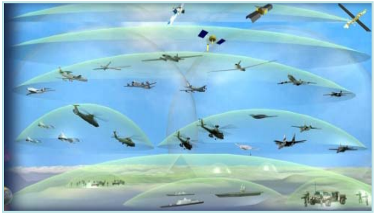
Integration Challenges: Some Drivers That Increase the Risk of Engineering Software-Intensive Systems



Platform	*Customer Emphasis* →	**Enterprise**
Requirements	*Acquisition Model* →	**Objectives/ Capabilities**
Dominant Prime	*Program Execution* →	**Strategic Teaming**
“Boxes”	*Integration Challenge* →	**“Layers & Stacks”**
Proprietary	*Architectures and Standards* →	**Plug & Play**

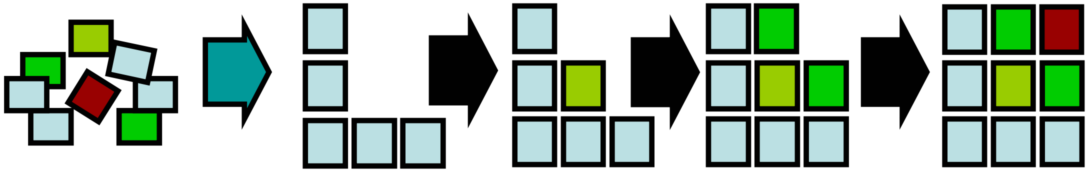
Need Exists to Address Both Sides, and Do So with Compressed Delivery Schedules via Improvements in Systems/Software Engineering

CMMI ® Product Integration (PI)



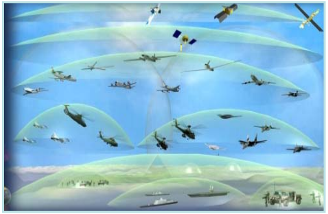
Purpose

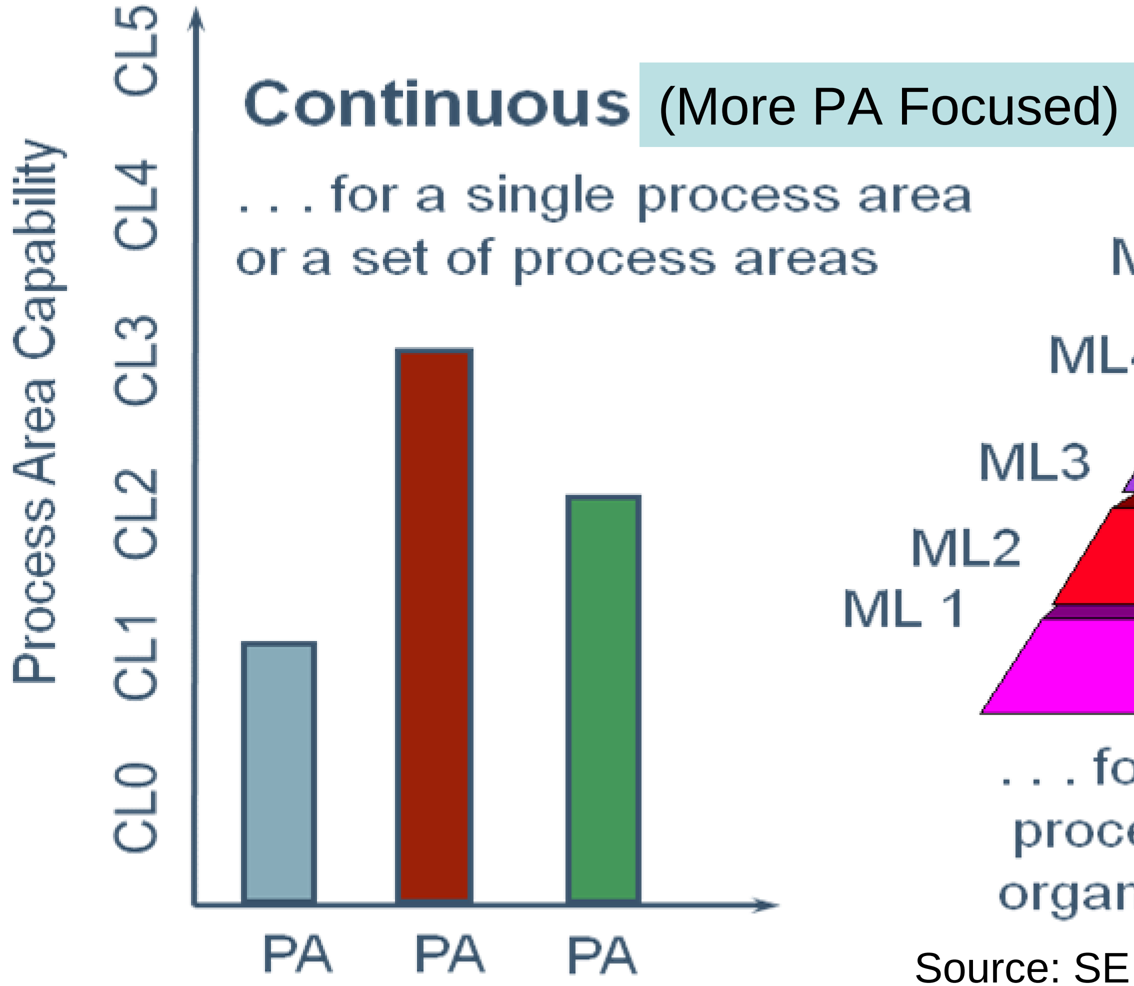
Assemble the product from the product components, ensure that the product, as integrated, functions properly, and deliver the product.

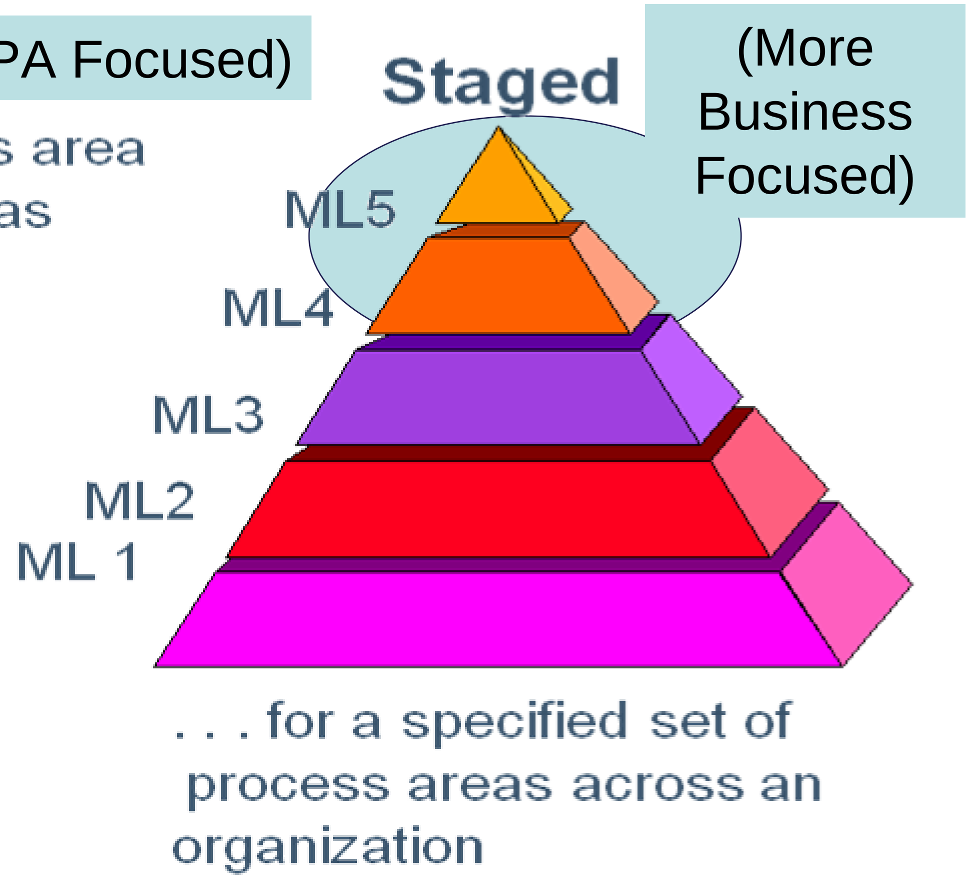


Source: SEI CMMI® Training Material

Two Representations – Focus at Higher Maturity May Be Different Depending on Representation

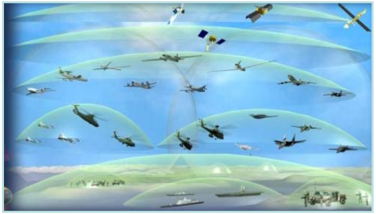






Source: SEI CMMI® Training Material

Staged Representation: PAs by Maturity Level

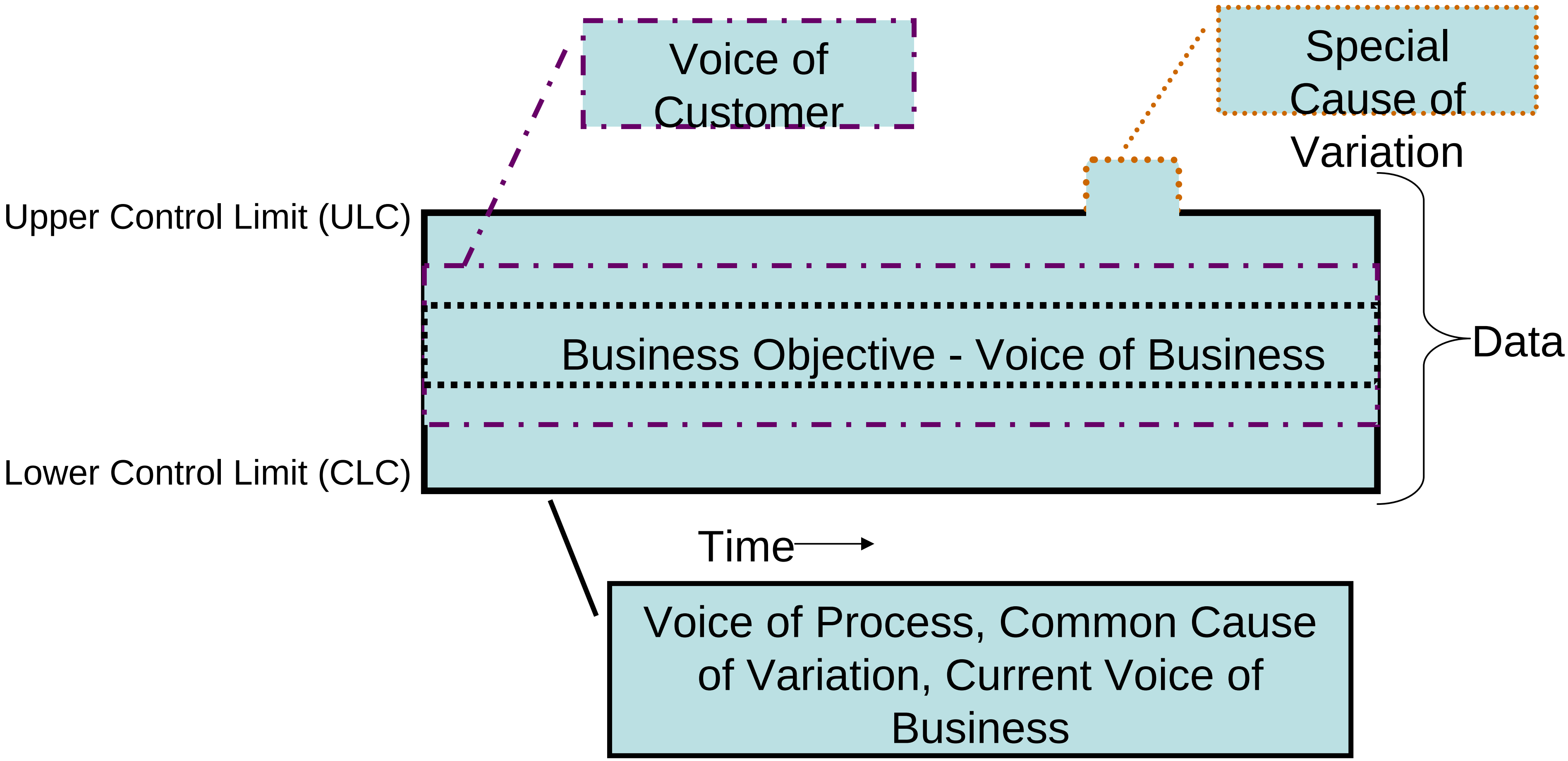


Level	Focus	Process Areas
5 Optimizing	*Continuous Process Improvement*	Organizational Innovation and Deployment Causal Analysis and Resolution
4 Quantitatively Managed	*Quantitative Management*	Organizational Process Performance Quantitative Project Management
3 Defined	*Process Standardization*	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition +IPPD Organizational Training Integrated Project Management +IPPD Risk Management Decision Analysis and Resolution
2 Managed	*Basic Project Management*	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
1 Initial		

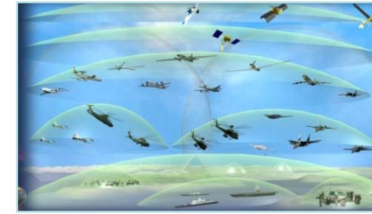
Risk
Rework

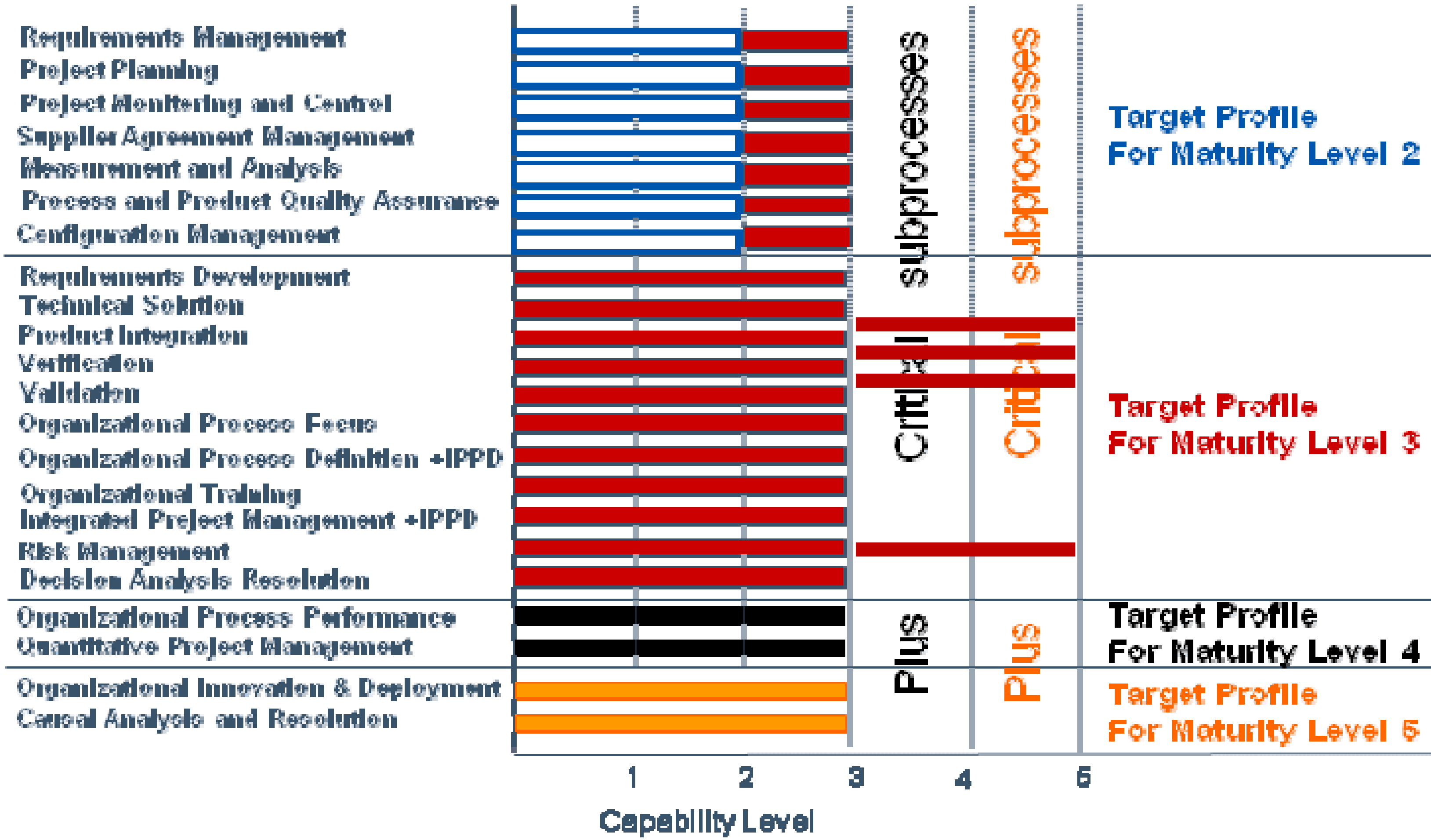
Source: SEI CMMI® Training Material

Run Chart - Definitions

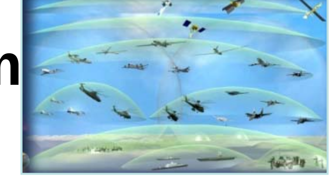


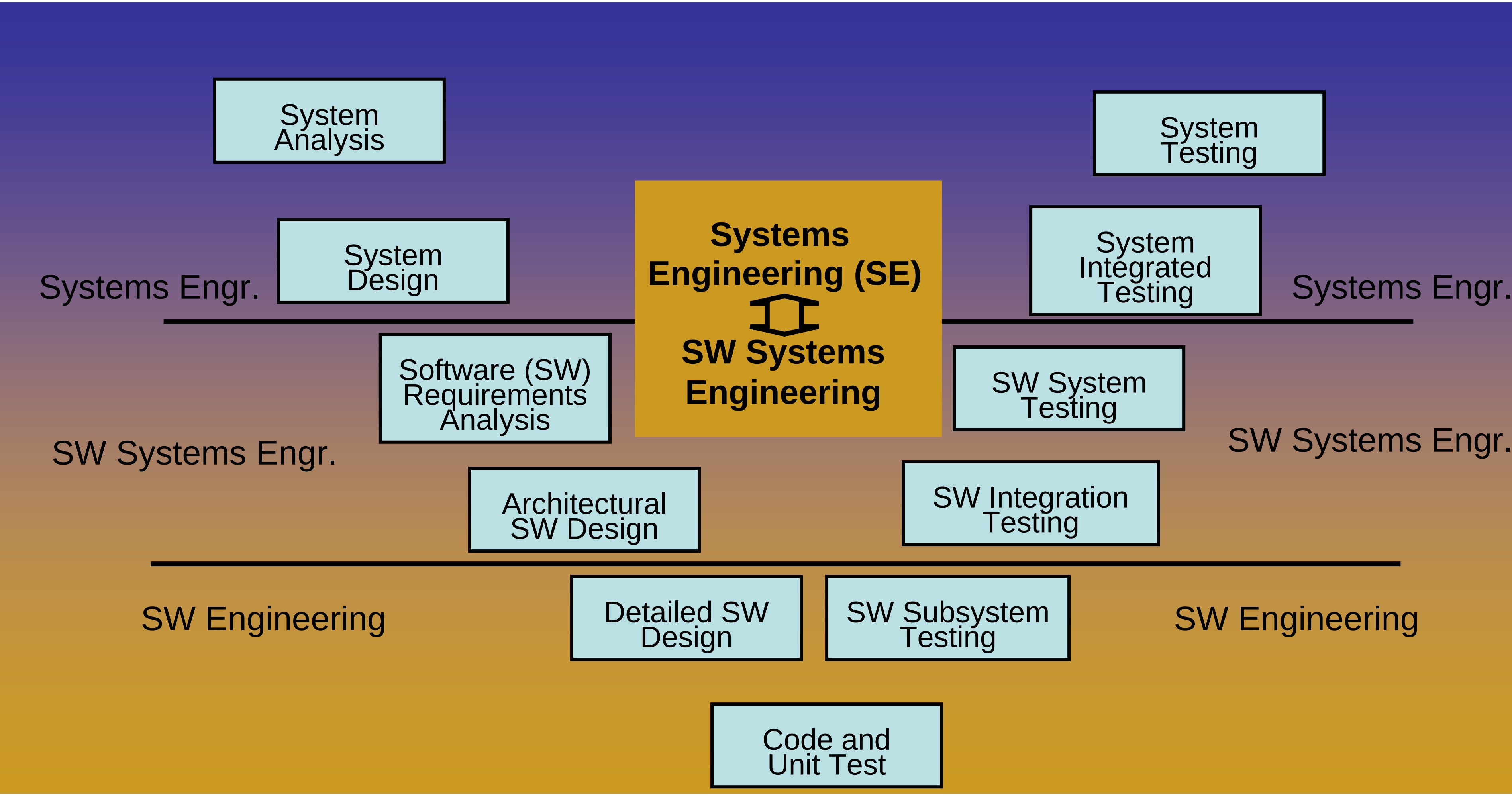
Focus on Business Objectives



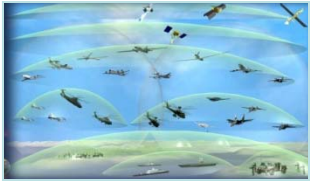


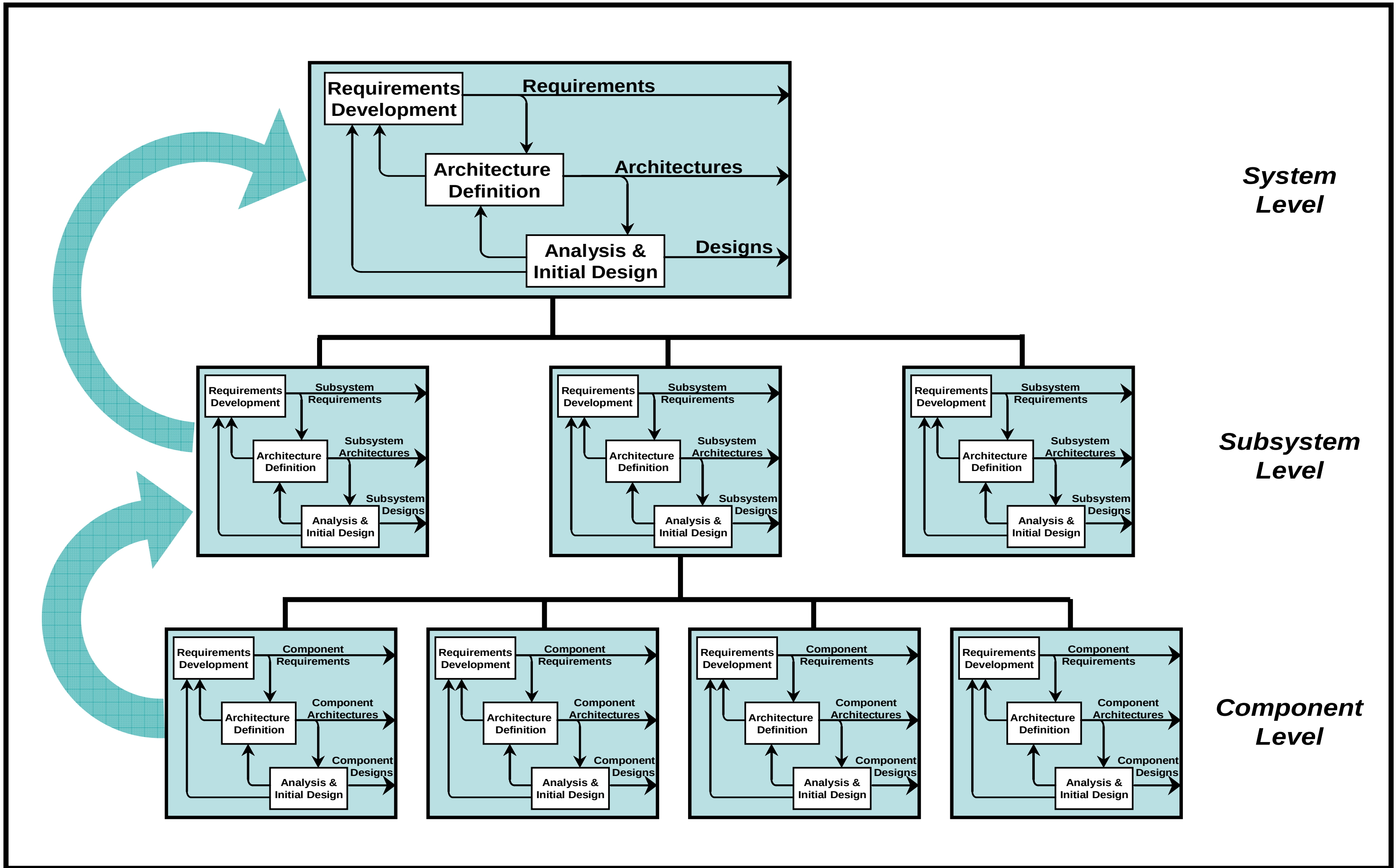
CMMI® Provides a Framework for Software and System Engineering to Become More Integrated



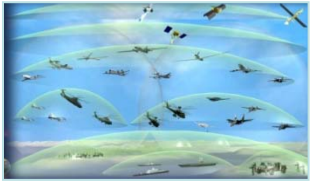


Prior to Product Integration – Left Side of Vee Chart





Product Integration Goals



SG 1: Prepare for Product Integration

Preparation for product integration is conducted.

SG 2: Ensure Interface Compatibility

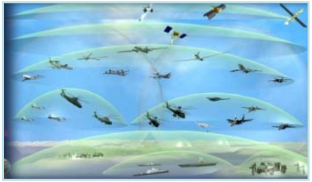
The product component interfaces, both internal and external, are compatible.

SG 3: Assemble Product Components and Deliver the Product

Verified product components are assembled and the integrated, verified, and validated product is delivered.

Source: SEI CMMI® Training Material

Product Integration Goals



DAR

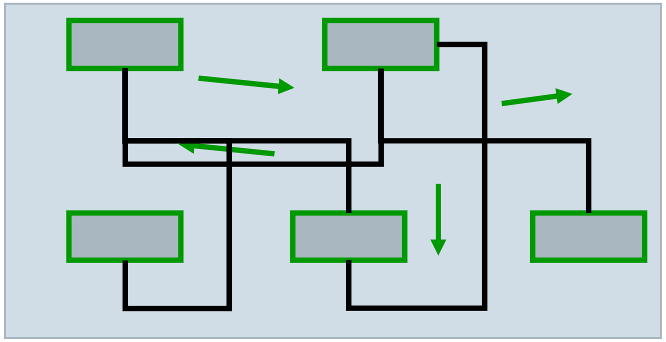
Prepare for Product Integration

Ensure Interface Compatibility

TS

Assemblies

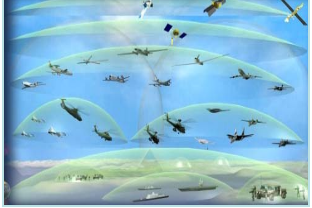
Sub-assemblies

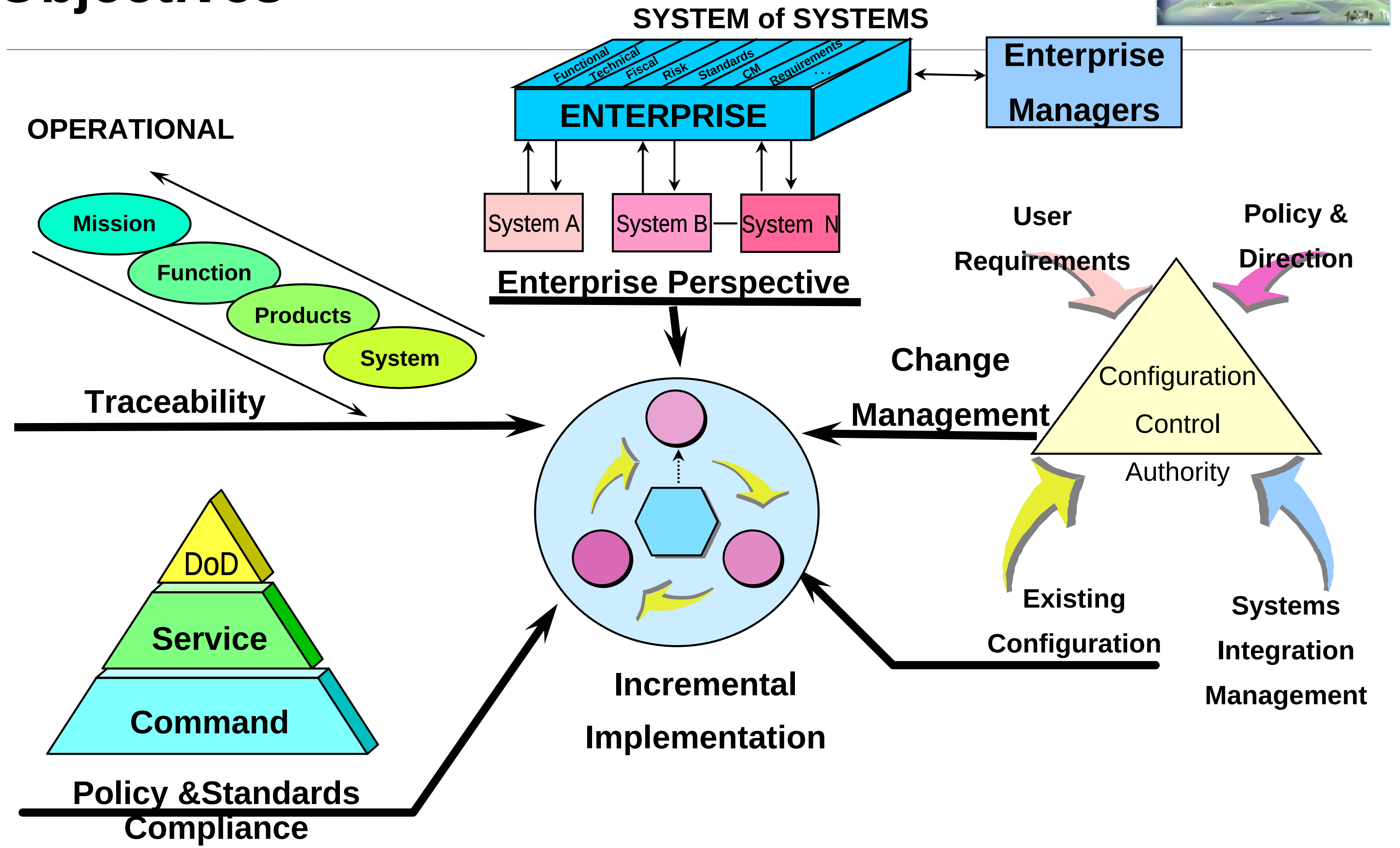


Assemble Product Components and Deliver the Product

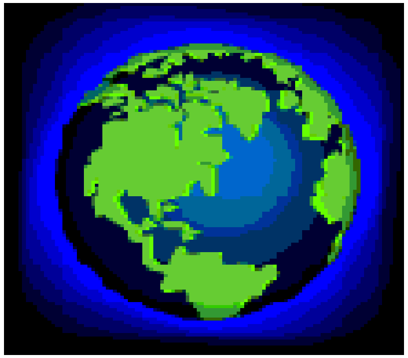
Source: SEI CMMI® Training Material

Integration Management By Business Objectives





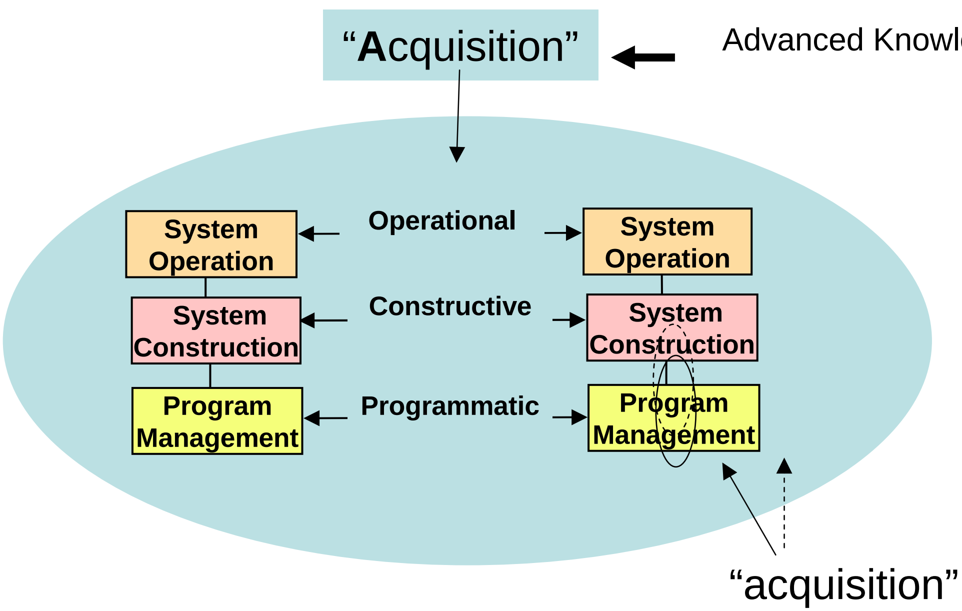
Engineering Integration – Achievement of Flexible Boundary-Crossing Acquisition Structure

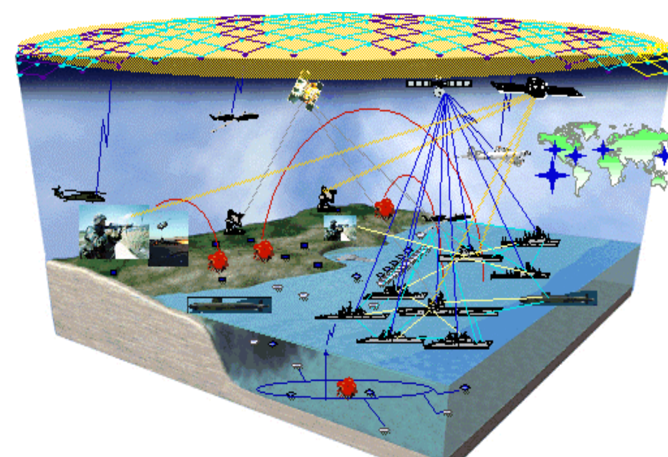


2005 study confirmed*:

- In advanced knowledge-based organizations, management's desire for the flow of knowledge is greater than the desire to control boundaries
- Unlike the matrix organization, there is less impact on the dynamics of formal power and control
- Important to measure the system in terms of user performance

* Using Communities of Practice to Drive Organizational Performance and Innovation, 2005, APQ study

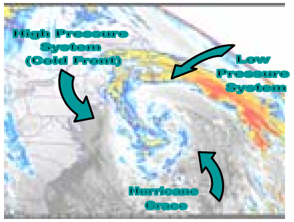




From "Science and Technology to Support FORCEnet," Raytheon TD-06-008. Used by permission.

Ref: Jim Smith, (703) 908-8221,jds@sei.cmu.edu

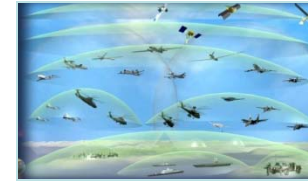
Northrop Grumman Unveils New Modeling and Simulation Research Center



New Aviation Ship Integration Center, a state-of-the-art research facility established in partnership with the U.S. Navy to conduct modeling, simulation, research, development and in-depth analysis for CVN 21-class aircraft carriers and other aviation-capable ships.

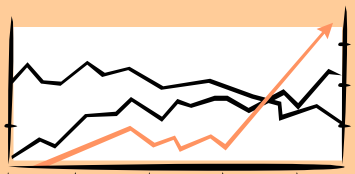
OSD (AT&L) Policy – Prototyping and Competition, 2007

Higher-Maturity Approaches to Process Improvement Are Important and Synergistic Trends



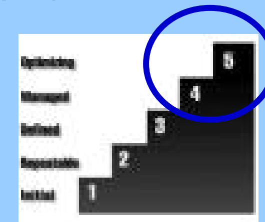
Data-Driven (e.g., Six Sigma, Lean)

Model-Driven (e.g., CMM, CMMI)



Optimizing

Quantitatively Managed



Determine what your processes can do (Voice of Process)

- Statistical Process Control

Clarify what your customer wants (Voice of Customer)

- Critical to Quality (CTQs)

Identify and prioritize improvement opportunities

- Causal analysis of data

Determine where your customers/competitors are going (Voice of Business)

- Design for Six Sigma

Determine the industry best practice

- Benchmarking, models

Compare your current practices to the model

- Appraisal, education

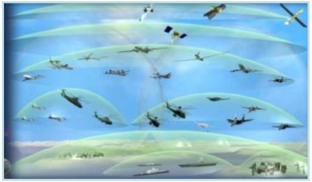
Identify and prioritize improvement opportunities

- Implementation
- Institutionalization

Look for ways to optimize the processes

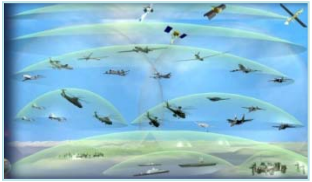
CMMI and Six Sigma,
Siviy, et al, 2007, Addison Wesley

Systems and Software Engineering: Ten Trends



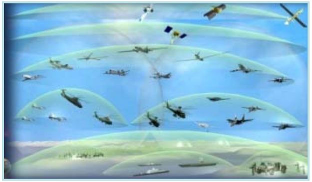
- Greater integration demands on systems and software engineers will stimulate growth in the field – nationally and internationally
- Industry/Gov't will increasingly focus on attracting, training and retaining systems and software engineering talent – short and long run – with emphasis on providing a more integrated work environment (7 by 24, any shore)
- Increased reliance on systems and software engineering processes and technologies to effectively manage integration issues
- The laws of Augustine's and Moore will continue to hold and will continue to be a forcing function to facilitate the need for integration

Systems and Software Engineering: Ten Trends



- *Improvements risk-reduction collaboration mechanisms will be significant enablers for increases in systems and software engineering communication and "decision velocity"*
- *Systems and software engineers will continually find way to innovative to reduce integration issues*
- *Increased importance of modeling and simulation*
- *Increased business focus for system and software engineering integration*
- *Shift of systems and software engineering focus from the platform to integrated networks and ground systems*
- *Use of CMMI-Dev will continue to be important!*


Questions?
THE
KNOWN WORLD
Beyond here there
be Dragons



Recommended Readings

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Wladawsky-Berger, Irving. "The Future of IT in an On-Demand World." IBM Server Group, Keynote address at OSBC 2005. Archived at http://www.itconversations.com/shows/detail495.html